

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended): A method of coating a surface of a titanium based ~~surface~~ substrate to provide oxidation protection and improved fatigue properties at elevated temperatures, comprising:
5 ~~applying a protective coating to the surface, the coating being~~
 ~~applied to the surface and having~~ an aluminum conversion layer to the surface
 to form a coated substrate, wherein the aluminum conversion layer is applied at
 a temperature below which aluminum does not appreciably react with titanium,
 and wherein the aluminum conversion layer is applied to of a thickness of ~~less~~
 ~~than~~ from about 2 to 12 microns; and
10 heat treating the ~~conversion layer~~ coated substrate in a two-step
 process so that:
 - i) a first portion of the aluminum conversion layer oxidizes
 to form an alumina layer; and
 - 15 ii) a second portion of the aluminum conversion layer
 interacts with the titanium within the titanium based substrate to form titanium
 aluminide.
2. (currently amended): The method of Claim 1, wherein ~~said~~
 ~~coating the titanium aluminide is formed as a layer having is applied at a~~
 thickness of ~~between about 2 to 12~~ from about 2 to 15 microns.
3. (currently amended): The method of Claim 1, wherein the
 aluminum conversion layer is transformed to the titanium aluminide by heating

5 at a controlled rate above about 500°C followed by a hold at a temperature no more than about 750°C, and cooling at a controlled rate back down to about 500°C.

4. (currently amended): The method of Claim 1, wherein the aluminum conversion layer is applied by gaseous deposition.

5. (original): The method of Claim 4, wherein the gaseous deposition and heat-treating are performed separately.

6. (currently amended): The method of Claim 1, wherein the aluminum conversion layer is applied at a temperature below 450°C.

7. (currently amended): The method of Claim 1, wherein the titanium aluminide is disposed between the alumina layer and the titanium based substrate conversion layer is oxidized to form an alumina surface layer.

8-11. (canceled)

12. (currently amended): A method of applying a coating to a titanium-based substrate, comprising:

5 cleaning a surface of the titanium-based substrate with a dilute caustic solution of KOH;

10 thereafter, applying an aluminum conversion layer of between 2 to 12 microns on the substrate by gaseous deposition, the aluminum conversion layer being deposited at a temperature below which aluminum does not appreciably react with titanium and below the melting point of Al; and
heat-treating the aluminum conversion layer so that the aluminum oxidizes to form alumina and interacts with the titanium to form the titanium

~~aluminide, and the conversion layer is oxidized to form an alumina surface layer.~~

13. (currently amended): The method of Claim 12; wherein the aluminum conversion layer is applied at a temperature below 450°C.

14-15. (canceled)

16. (currently amended): The method of Claim ~~15~~ 12, wherein the aluminum conversion layer is transformed to titanium aluminide by heating at a controlled rate to a temperature of below 640°C ~~after cleaning the surface.~~

17. (currently amended): A method of coating a surface of a titanium based ~~surface~~ substrate to provide oxidation protection at elevated temperatures, comprising:

cleaning the surface of the titanium-based substrate with a dilute
5 caustic solution of KOH;

thereafter, ~~applying a protective coating to the surface, the coating being applied by applying an aluminum conversion layer to the surface at a temperature below which aluminum does not appreciably react with titanium and of a thickness of less than 12 microns; and~~

10 heat treating the aluminum conversion layer so that the aluminum oxidizes to form alumina and interacts with the titanium to form titanium aluminide; and

~~cleaning the titanium-based alloy surface prior to applying a protective coating.~~

18. (canceled)

19. (currently amended): The method of Claim 18 ~~17~~, wherein a first portion of the aluminum conversion layer is oxidized to form alumina, and a second portion of the aluminum conversion layer is transformed to titanium aluminide by heating at a controlled rate of ~~below 640°C after cleaning the~~
5 ~~surface.~~

20-24. (canceled)

25. A method of applying a coating to a brazed substrate comprising:
applying an aluminum conversion layer of ~~between 2 to 12~~
microns on a braze of the substrate by gaseous deposition, the layer being
5 deposited at a temperature below which aluminum does not appreciably react
with any titanium ~~which may or may not be present in the braze; and~~
heat treating the aluminum conversion layer so that the aluminum
diffuses into the braze to form a solid solution within the braze, and the
aluminum further oxidizes to form an alumina surface layer on the braze, and if
10 ~~the braze contains Ti, interacts with the titanium to form titanium aluminide.~~

26. (new): The method of Claim 1, wherein the titanium aluminide comprises the phase $TiAl_3$.

27. (new): The method of Claim 1, wherein the alumina layer has a thickness of from about 0.5 to 5 microns.

28. (new) The method of Claim 12, wherein the aluminum conversion layer is applied at a thickness of between 2 to 12 microns.

29. (new): The method of Claim 25, wherein the braze includes titanium, and the aluminum interacts with the titanium to form a layer of titanium aluminide on the braze.

30. (new): A method for forming an oxidation protective coating on a titanium-based substrate, comprising:
- a) depositing an aluminum conversion layer on a surface of the titanium-based substrate, wherein the aluminum conversion layer comprises aluminum;
 - b) oxidizing a first portion of the aluminum to form an outer alumina layer; and
 - c) reacting a second portion of the aluminum with titanium of the titanium-based substrate to form a layer of titanium aluminide beneath the alumina layer, wherein step b) is performed at a first temperature, and step c) is performed at a second temperature, and wherein the second temperature is higher than the first temperature.
31. (new): The method of Claim 30, wherein the first temperature is about 400° C.
32. (new): The method of Claim 31, wherein the second temperature is about 700° C.
33. (new): The method of Claim 30, wherein step a) is performed at a temperature less than about 550° C.
34. (new): The method of Claim 30, wherein at least one of steps b) and c) is performed in a vacuum furnace.
35. (new): The method of Claim 30, further comprising: prior to step a), cleaning the surface of the titanium-based substrate.
36. (new): A method for forming an oxidation protective coating on a surface of a titanium-based substrate, comprising:

- a) depositing an aluminum conversion layer on the surface of the titanium-based substrate;
- 5 b) oxidizing a first portion of the aluminum conversion layer to form an outer alumina layer; and
- c) diffusing a second portion of the aluminum conversion layer into the titanium-based substrate, wherein a titanium aluminide layer is formed beneath the alumina layer, wherein step b) is performed at a first temperature, 10 step c) is performed at a second temperature, and wherein the second temperature is substantially higher than the first temperature.

37. (new): The method of Claim 36, further comprising:
d) prior to step a), cleaning the surface of the titanium-based substrate with a caustic solution.

38. (new): The method of Claim 36, wherein step b) is performed at a temperature of about 400° C, and step c) is performed at a temperature of about 700° C.

39. (new): A method for forming an oxidation protective coating on a surface of a titanium-based substrate, comprising:

- a) depositing an aluminum conversion layer on the surface of the titanium-based substrate, wherein the aluminum conversion layer is deposited 5 at a temperature of less than about 550° C;
- b) heat treating the aluminum conversion layer at a controlled rate to form a coated substrate comprising an outer alumina layer and a titanium aluminide layer, wherein the titanium aluminide layer is formed between the titanium-based substrate and the alumina layer; and
- 10 c) cooling the coated substrate at a controlled rate, whereby cracking of the titanium aluminide layer is prevented.

40. (new): The method of Claim 39, wherein step b) comprises heating the aluminum conversion layer at a rate of from about 25 to 100° C per hour when the temperature during step b) is above 500° C, and wherein step c) comprises cooling the coated substrate at a rate of from about 15 to 60° C per hour.

41. (new): The method of Claim 39, further comprising:
d) prior to step c), holding the temperature attained during step b) for a period of from about 5 minutes to 2 hours.

42. (new): The method of Claim 39, wherein step a) comprises depositing the aluminum conversion layer to a thickness in the range of from about 0.5 to 40 microns, and wherein the titanium aluminide layer is formed to a thickness in the range of from about 1 to 80 microns.

43. (new): A coated titanium-based substrate prepared according to the method of Claim 36.

44. (new): An oxidation protective coating for a titanium-based alloy substrate, comprising:
a layer of titanium aluminide disposed directly on a surface of the titanium-based alloy substrate, wherein the layer of titanium aluminide comprises TiAl_3 ; and

a layer of alumina (Al_2O_3) disposed directly on the layer of titanium aluminide, wherein the layer of alumina has a thickness in the range of from about 0.5 to 5 microns.

45. (new): The oxidation protective coating of Claim 44, wherein the layer of titanium aluminide has a thickness in the range of from about 1 to 80 microns.

46. (new): The oxidation protective coating of Claim 44, wherein the layer of titanium aluminide has a thickness in the range of from about 2 to 15 microns.

47. (new): The oxidation protective coating of Claim 44, wherein the titanium-based alloy substrate includes a braze disposed on a surface of the titanium-based alloy substrate, the braze comprises titanium, and wherein the oxidation protective coating is formed on the braze.

48. (new): A titanium-based component, comprising:
a titanium-based substrate; and
an oxidation protective coating disposed on the titanium-based substrate, and wherein the oxidation protective coating comprises:
5 a layer of titanium aluminide disposed directly on a surface of the titanium-based substrate, wherein the layer of titanium aluminide comprises TiAl_3 ; and
a layer of alumina (Al_2O_3) disposed directly on the layer of titanium aluminide, wherein the layer of alumina has a thickness in the range of
10 from about 0.5 to 5 microns.

49. (new): The titanium-based component of Claim 48, wherein the component comprises a panel of a heat exchanger.

50. (new): The titanium-based component of Claim 48, wherein the component comprises a braze disposed on the titanium-based substrate,

the layer of alumina is disposed over the braze, and the braze includes a solid solution of aluminum.